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U.S./Canada Negotiation Studies

Prepared By

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OEO/ADA STATEMENT

TABLE OF CONTENTS

I. INTRODUCTION

The United States and Canada began negotiations on Yukon River salmon in March 1985. When in progress, negotiations are held about twice per year. The negotiations have relied heavily on information supplied by the Alaska Department of Fish and Game (ADF&G) about the salmon fisheries and stocks in the Yukon River drainage. Some of that information has been gained because of specific appropriations from Congress passed through the Department of Commerce to ADF&G. Federal FY 1996 funds were passed through to ADF&G to provide support for negotiation meeting costs and field data collection for the period 1 July 1996 through 30 June 1997 through grant Award No. NA46FP0343-2.

The purpose of the program supported by Federal funds for Yukon River salmon negotiation studies is to help provide the technical support necessary to effectively manage the complex Yukon River salmon fisheries in the context of the U.S./Canada negotiation process, as well as to help provide support for the treaty negotiation process.

The Yukon River (Figures 1 and 2) is the largest river in Alaska, and one of the largest in North America. It drains an area of approximately 330,000 square miles, nearly two-thirds of which is in Alaska. For perspective, the Yukon River drainage exceeds the combined areas of the U.S. Pacific coast states of Washington, Oregon, and California combined. The area is mostly remote, undeveloped, and in its natural pristine condition. The Yukon River supports one of the largest runs of chinook and chum salmon in the world.

Providing harvest opportunity among the many users along the river in both the United States and Canada, and conserving specific stocks in a fully developed fishery harvesting from a mixture of stocks, makes the Yukon River one of the most challenging salmon fisheries to manage for optimum sustainable yields. The Yukon River Joint Technical Committee (JTC) has determined that the technical program, for both countries, is inadequate to meet the requirements that might be expected with a treaty management regime.

This report serves as a completion report in summary form for six field data collection projects or activities funded with this grant for the period 1 July 1996 through 30 June 1997, which was essentially the 1996 field season for these projects. The salmon catch and escapement sampling activity is ancillary to the stock identification project. Specifically, the projects or activities described in this report are as follows:

1) Chinook Salmon Stock Identification Using SPA, 1996
2) Yukon River Salmon Stock Identification Using GSI, 1996
3) Salmon Catch and Escapement Age-Sex-Length Sampling, 1996
4) Subsistence Harvest Estimation, 1996

5) Spawning Escapement Surveys, 1996
6) Lower Yukon River Sonar at Pilot Station, 1996

Results from each of these projects or activities will be summarized in the subsequent individual sections of this completion report. Reference will be provided to specific reports in preparation or already completed which provide a more comprehensive source of information on the background for these projects or activities, the methods used, the results and discussion, and literature references.

CHINOOK SALMON STOCK IDENTIFICATION USING SPA, 1996

Yukon River chinook salmon are harvested in subsistence and personal use fisheries in Alaska, Aboriginal and domestic fisheries in Canada, and commercial and sport fisheries in Alaska and Canada. Chinook salmon harvested in the Yukon River fisheries consist of a mixture of stocks destined for spawning areas throughout the Yukon River drainage. Although more than 100 spawning streams have been documented, aerial surveys of chinook salmon escapements indicate that the largest concentrations of spawners occur in three distinct geographic regions: (1) tributary streams in Alaska that drain the Andreafsky Hills and Kaltag Mountains between river miles 100 and 500, (2) Upper Koyukuk River and Tanana River tributaries in Alaska between river miles 800 and 1,100, and (3) tributary streams in Canada that drain the Pelly and Big Salmon Mountains between river miles 1,300 and 1,800. Chinook salmon stocks within these geographic regions are collectively termed the Lower, Middle, and Upper Yukon Runs. For management purposes the Alaska portion of the drainage is divided into six districts.

Evaluating stock productivities, spawning escapement goals, and management strategies requires information on the stock composition of the harvest. The U.S. and Canada are engaged in treaty negotiations concerning management and conservation of stocks spawned in Canada. Biological information on these stocks provides the technical basis for the negotiations. The objective of this project is to classify all chinook salmon harvests in the Yukon River drainage to run of origin primarily using scale pattern analysis (SPA). A more comprehensive source of information on the background of this project, the methods used, the results and discussion for 1996, and literature references can be found in Schneiderhan (In Prep).

Chinook salmon scale samples provided age information for fish in the catch and escapement. Scales were collected from commercial catches in all fishing districts in 1996 except District 3. District 3 was not targeted for sampling because relatively few fish were harvested in that portion of the Yukon River and access was difficult. Salmon harvested in District 3 and delivered to buyers in District 2 could at times have comprised a small fraction of the District 2 catch sample. For purposes of this report, it was assumed that subsistence fishing in District 1 and 2 occurred prior to or near the beginning of commercial fishing and could therefore be described using the Period 1 commercial sample data for each district. Spawning escapement scale samples were collected during the period of peak spawner mortality from the Anvik, Chena, and Salcha Rivers in Alaska. Carcasses were the primary source of

these samples; however, some were obtained from live, spawned-out fish captured with spears or other methods. Live salmon were sampled on the East Fork of the Andreafsky River at a weir project operated by the U.S. Fish and Wildlife Service. Canadian tributaries were not sampled in 1996. However, samples for use as stock standards were collected from chinook salmon captured in fish wheels by personnel from the Canadian Department of Fisheries and Oceans (DFO) in Yukon Territory, Canada. The age composition of Lower, Middle, and Upper Yukon Runs was estimated as the combined age composition calculated for the individual spawning tributaries in each area.

Linear discriminant functions (LDF) analysis of scale patterns data were used to classify the two major age classes, e.g., ages 1.3 and 1.4, to run of origin. Minor age classes were estimated using the major age class results in conjunction with observed differences in age composition between escapements and geographic occurrence for the 1996 Yukon River chinook salmon catches.

Yukon River chinook salmon escapement age compositions in 1996 exhibited variations of trends and characteristics seen in other years. Further discussion of age information is provided in the section of this report on salmon catch and escapement age-sex-length sampling.

A 3-way run classification model consisting of separate standards for Lower, Middle, and Upper Yukon stocks was used in 1996. Preliminary results will be reported here, but are subject to further research and analysis. The mean classification accuracy of the run of origin model was 67.2% for age 1.3 and 58.0% for age 1.4. Though accuracy was lower than most other years, the classification matrices showed a higher degree of symmetry than usual. Unlike past years, the middle river standard showed the greatest classification accuracy for age 1.4 (63.6%). Also atypically, the upper river standard provided the greatest classification accuracy for age 1.3 (77.2%). Upper river standards most often misclassified to the Middle Yukon Run (12.4% for age 1.3 and 28.6% for age 1.4). Middle river standards for age 1.3 misclassified most often to the Lower Yukon Run (25.6%), while middle river age 1.4 most often misclassified to the Upper Yukon Run (23.2%).

The commercial and subsistence harvest from the entire Yukon River drainage of 158,291 chinook salmon was classified to run of origin based on (1) findings of the scale pattern analysis for age-1.3 and -1.4 fish in District 1 and 2 commercial catches, (2) age composition analysis of the remaining age classes, (3) assumptions concerning unsampled fisheries, and (4) stock origins based on geographical segregation. The Upper Yukon Run was the largest estimated run component and contributed 97,916 fish or 61.9% of the total drainage harvest. The Lower Yukon Run was next in abundance at 48,850 fish (30.9%), followed by the Middle Yukon Run at 11,524 fish (7.2%).

The estimated commercial harvests of ages 1.3 and 1.4 in Districts 1 and 2 combined was 68,145 chinook salmon or 43.1% of the total Yukon River drainage catch. The estimated District 1 commercial catch of age-1.3 and -1.4 fish combined was 15,157 (35.0%) Lower, 4,374 (10.1%) Middle, and 23,747 (54.9%) Upper Yukon Run. In District 2 the estimated age-1.3 and -1.4 combined catch was 7,830 (31.5%) Lower, 1,692 (6.8%) Middle, and 15,345 (61.7%) Upper Yukon Run. The commercial chinook salmon catch in Districts 1 and 2 was relatively evenly distributed throughout all

six fishing periods with a gradual drop in catches as the season progressed. Upper Yukon Run fish comprised the largest proportion of the District 1 commercial harvest of age-1.3 chinook salmon in all periods. Upper run fish comprised the largest proportion of the District 1 commercial harvest of age-1.4 chinook salmon in periods 1, 3, 5, and 6. Similarly, in District 2 Upper Yukon Run fish were the strongest segment of the catch of age 1.3 in all periods; however, age 1.4 upper run fish dominated the catch only in period 2 and were absent or nearly so in periods 1, 4, and 5. Age 1.4 middle run fish were also absent or weak in all periods in both Districts 1 and 2. As noted in prior years, run contributions through time in District 1 generally demonstrated increasing proportions of Lower Yukon fish and decreasing proportions of Upper Yukon fish. The Middle Yukon Run was relatively most abundant in period 5.

The proportion of total drainage harvest that was attributed to the Upper Yukon Run was 61.8%. Estimates of the Upper Yukon Run component have ranged from 35.4% in 1984 to the high of 74.8% (preliminary analysis) for 1995 with an overall average of 58.4% since 1982. The proportion of Lower Yukon Run was the same as the 1985 highest on record (30.9%) while the Middle Yukon Run was second lowest at 7.3%.

Commercial chinook salmon harvests in the lower Yukon Area during the years since the implementation of current guideline harvest ranges included a component of age 1.3 and younger salmon which were most heavily harvested during restricted mesh-size periods. Those periods were designed to specifically target chum salmon; however, the smaller mesh size also resulted in an increased proportion of age-1.3 and younger chinook salmon in the district commercial harvest. Because of poor summer chum salmon runs and/or weakening market conditions for summer chum salmon, there have been typically fewer restricted mesh size openings in Districts 1 and 2 in recent years. In Districts 1 and 2 in 1996, all summer season commercial openings were with unrestricted mesh size. Season harvests from predominantly unrestricted mesh-size openings are comprised of proportionally more larger, older chinook salmon, which are comprised of a larger proportion of females than are found in younger fish. Therefore, in years when the number of commercial unrestricted mesh-size openings in the fishing season produce large catches of large fish, managers should continue to set harvest targets that reflect the larger impact of unrestricted gear on the female catch component.

Attainment of sample size objectives presented in the annual sampling plan is a fair measure of operational success. For all escapements which contribute to the standard three-way LDF classification model, sample sizes were good to excellent. Acceptable sample quality depends on biological and sampling factors. When the expected rejection rate is exceeded for scale specimens, the quantity of acceptable specimens becomes problematic. The rejection rate due to sampling technique is a key factor in determining sample sizes. In order to optimize sampling effort, sampling technique must also be optimized; therefore, the production of good quality samples will continue to be emphasized in sampling plans.

Sampling upper Yukon tributaries in Canada is of continuing concern. The Upper Yukon Run is sampled in Canada near the U.S.-Canada border at the DFO tagging project sites. Total abundance estimates for the Upper Yukon Run have been obtained from that study, and scales taken from chinook salmon have provided the Upper Yukon Run scale pattern standard when commercial harvest samples and/or escapement samples were inadequate or unavailable, as in 1996. For assignment of harvests to run of origin, the approach of using samples from the DFO mainstem Yukon River test fish wheels to build stock allocation models assumes that those samples are representative of the run of Canadian-spawned chinook salmon. Test fish wheels may not catch all sizes of chinook salmon and all component stocks in proportion to their abundance. Appropriately weighted escapement samples could improve the construction of the Upper Yukon Run stock composition model. Unfortunately, escapement sampling is not conducted in conjunction with escapement abundance estimation for the Upper Yukon Run stock standard. At this time the scales collected from tagging fish wheel catches are accepted as the best available source. The dominant age classes which are modeled for the SPA analysis are adequately represented in catches from the tagging study fish wheels and the sample is assumed to represent age and stock compositions in Canadian harvests, as well as total Upper Yukon Run escapements.

Failure to obtain appropriate sample sizes to adequately represent the Upper Yukon Run would seriously weaken or invalidate the SPA analysis. Lack of escapement sampling in Canada highlights the importance of DFO test fish wheel scale samples as the sole source for the Upper Yukon Run chinook SPA stock standard and for sex and age composition of salmon in Canada. The lack of escapement sampling in the Canadian portion of the drainage in recent years results in a serious void of basic biological information for modeling the population dynamics and stock composition of Yukon River salmon.

YUKON RIVER SALMON STOCK IDENTIFICATION USING GSI, 1996

ADF&G genetics staff worked with USFWS staff to prepare a draft report (Crane, et al. In Prep) summarizing allozyme data for Yukon River chum salmon collected through 1996. In the report, a new baseline using all available genetic data was assembled and tested. The ability of reporting groups to be identified in mixtures was evaluated using simulations where 100% of an artificial mixture was sampled from a single reporting group. Correct mean allocations from 100 simulations exceeded 90% for five reporting groups: Lower Yukon River Summer, Tanana River Fall, Chandalar/Sheenjek/Fishing Branch/Canadian Mainstem, Teslin River, and Kluane River. Results of simulated mixtures composed of multiple reporting groups indicated that the presence of a reporting group could reliably be detected if that reporting group formed greater than 15 to 20% of the mixture. The report is currently undergoing final review.

A draft manuscript has been prepared summarizing the results of a collaborative ADF&G, USFWS, and USGS-BRD project examining the utility of DNA markers to separate fall-run chum salmon in the Yukon River. Estimates of the extent of population differentiation were highly

concordant among the protein, nuclear DNA, and mitochondrial DNA markers tested. The manuscript will be ready for submission in the fall of 1997.

Finally, genetics staff from ADF&G worked closely with other members of the Stock Identification Subcommittee of the JTC on a draft report that summarizes the status and capabilities of stock identification techniques for chum salmon and chinook salmon in the Yukon River. The report is currently undergoing its second review, and is targeted for finalization in the fall of 1997.

SALMON CATCH AND ESCAPEMENT AGE-SEX-LENGTH SAMPLING, 1996

Samples for age, sex, and length (ASL) composition of salmon were obtained in conjunction with sampling of salmon for stock identification purposes. Additionally, salmon were sampled at selected locations in the Alaska portion of the Yukon River drainage from both catches and escapements for ASL data. It is envisioned that this information will be incorporated into a Yukon River salmon ASL data catalog, which is in the conceptual development stage at this time. Some of the ASL data presented here was collected from projects that were not funded with this U.S. Department of Commerce grant, but the information is presented here in order to provide a more complete overview of the ASL information.

Sampling objectives for each species were established which were designed to provide acceptable levels of precision and accuracy ($\delta = 0.05$, $\alpha = 0.01$) of composition analyses. The sample size required for a three age category analysis of chum salmon, assuming a ten percent rate of unusable samples, was 160 fish. A four age category analysis for chinook salmon, assuming a 10 percent or smaller rate of unusable samples, required samples from 180 fish. In order to attain a 10 percent or smaller rate of unusable samples for chinook, three scales, rather than one, were taken from each fish. The sample size required for a two age category analysis of coho salmon, assuming a 10 percent or smaller rate of unusable samples, required samples from 120 fish.

Preliminary summary information indicates that commercial, subsistence, test fishery, and escapement sampling in 1996 provided useable samples from on the order of 7,000 chinook, 12,000 summer chum, 3,000 fall chum, and 2,000 coho salmon. Escapement sampling was conducted on the Andreafsky, Anvik, Chatanika, Chena, Clear Creek, Delta, Gisasa, Kaltag Creek, Koyukuk, Nulato, Salcha, Sheenjek, and Toklat Rivers in Alaska. Additional salmon ASL samples were collected by DFO from the White Rock and Sheep Rock tagging project fish wheels just upriver from the U.S./Canada border.

Ages 1.3 and 1.4 were typically the two principle age classes of chinook salmon taken in commercial gear. However, 1996 commercial samples from the Yukon River District 1 and 2 catches showed a lower than usual proportion of age-1.4 fish and a higher than usual proportion of age-1.5 fish. Because there was no market for chum salmon in 1996, large mesh size or

unrestricted mesh size gillnet gear was used to target chinook salmon while limiting the magnitude of the chum salmon catch. Chinook salmon samples from large mesh size gear would normally contain larger proportions of the older age-1.4 fish. Samples obtained from chinook salmon taken in District 1 and 2 commercial catches were composed of 37% to 45% age 1.3, 34% to 38% age 1.4, and 19% to 24% age 1.5.

Chinook salmon escapement samples from the lower Yukon River tributaries were composed of significant proportions of age-1.3 fish: e.g., 74% for the Andreafsky, 55% for the Anvik, and 60% for the Gisasa Rivers. The proportions of age-1.3 fish in the middle Yukon River tributaries were generally lower, i.e., 44% for the Chena, 39% for the Salcha, and 63% for the Koyukuk River. Chinook salmon aged 1.4 were only 14% of the Andreafsky, 24% of the Anvik, and 14% of the Gisasa River samples. Samples from the middle Yukon River tributaries also showed proportions of age-1.4 that were lower than District 1 and 2 catches, i.e., the Chena, Salcha, and Koyukuk River samples were 24%, 29%, and 23% age 1.4, respectively. Chinook salmon samples from the Canadian tagging project fish wheels were composed of 60% age 1.3 and 27% age 1.4. It should be noted that fish wheels normally tend to select for smaller chinook, more of which are typically younger males.

Yukon River chum salmon runs are composed principally of age-0.3 and -0.4 fish. Samples taken from commercial catches of summer chum ranged from 59% age 0.4 in Districts 1 and 2 to between 42% - 53% in District 4. Age 0.4 composed 35% for the Andreafsky River summer chum salmon escapement sample, 42% for the Anvik River, 50% for the Gisasa River, 47% for the Nulato River and 33% for Clear Creek.

Fall chum salmon were sampled from commercial and test fishing catches, as well as tributary escapements in 1996. Samples were 36% to 50% age-0.4 fish in District 1 and 2 commercial catches. District 1 test fishing samples were composed of 26% to 40% age-0.4 fish. Escapement samples from the Delta, Toklat, and Sheenjek Rivers were composed of 33% to 56% age-0.4 fish.

Coho salmon were sampled from the District 1 commercial catch, District 1 test fishing catch, as well as from the Andreafsky and Delta Clearwater River escapements. District 1 commercial and test fishing catches were composed of 84% to 89% age 2.1, while the Andreafsky and Delta Clearwater River escapement samples were both about 97% age 2.1.

SUBSISTENCE HARVEST ESTIMATION, 1996

Successful management of the Yukon River fishery resources depends upon accurate estimates of subsistence harvests. Estimates of subsistence salmon harvests presented in this report may not be strictly comparable to some historical estimates for a number of reasons: 1) commercially harvested fish retained for subsistence purposes have been included in the estimates of subsistence harvests for some years and not included for other years; 2) village survey dates early in the fall in some years would

result in harvest estimates less than the actual harvest levels due to the amount of harvest which occurred after the interviews were conducted; and 3) sampling design and questions have changed periodically throughout the history of the program. Although comparing historical harvest estimates of subsistence salmon to more recent estimates is difficult due to the varied methodologies, it is felt that the estimates do reflect harvest trends. A more comprehensive source of information on the background of this project, the methods used, the results and discussion for 1996, and literature references can be found in Borba and Hamner (1997).

The number of salmon harvested in the subsistence and personal use fisheries in the Yukon River drainage in Alaska in 1996 was estimated from survey and fishing permit programs. Additionally, the number of fish given to the public for subsistence use from various test fishing projects throughout the drainage were also documented.

The majority of Yukon Area villages have no regulatory requirements to report their subsistence salmon harvest. To estimate the salmon harvest from these villages the department has implemented a voluntary survey program. The 1996 survey program utilized subsistence harvest calendars, postseason household interviews, and postseason household telephone interviews and postal questionnaires. Stratified random sampling techniques were used to select Yukon Area households to be interviewed in 1996. Based on information collected from 951 households that were contacted by surveyors, an estimated total of 38,592 chinook *Oncorhynchus tshawytscha*, 172,153 chum *O. keta*, and 14,460 coho salmon *O. kisutch* were harvested by subsistence fishermen in the survey portion of the Yukon Area in 1996. The chum salmon run is made up of an early (summer) and later (fall) salmon run. The chum salmon harvest was separated into 105,921 summer chum and 66,232 fall chum salmon.

A portion of the Yukon Area requires subsistence or personal use fishermen to obtain an annual household permit prior to fishing. In these areas, the fishermen are required to document their harvest on the household permit and return the permit to the department at the end of the season. A total of 518 subsistence and personal use permits were issued in 1996. A total of 486 subsistence and personal use permits (94% of the total permits issued) had been returned to the department as of April 10, 1997. A total of 279 permit holders (57% of the total permits returned) indicated they fished in 1996. The reported permit harvest was 5,939 chinook, 12,394 summer chum, 60,411 fall chum, and 15,134 coho salmon. This reported harvest does not include Stevens Village household permit harvest information. The Yukon River permit information reported by Stevens Village residents was used to supplement the postseason survey of that village.

From the test fishery projects throughout the drainage, a total of 1,355 chinook, 7,328 summer chum, 2,971 fall chum, and 1,008 coho salmon were given away to households for subsistence use.

Combining survey, permit, and test fishery information, an estimated 45,886 chinook, 125,643 summer chum, 129,614 fall chum, and 30,602 coho salmon were harvested by an estimated 1,421 Yukon Area subsistence and personal use fishing households in 1996.

SPAWNING ESCAPEMENT SURVEYS, 1996

An essential requirement for management of the Yukon River salmon fisheries is the documentation of annual salmon spawning escapements. Such documentation provides for determination of appropriate escapement levels or goals for selected spawning areas or management units; evaluation of escapement trends; evaluation of the effectiveness of the management program, which in turn forms the basis for proposing regulatory changes and management strategies; and evaluation of stock status for use in projecting subsequent returns.

The Yukon River drainage is too extensive for comprehensive escapement coverage of all individual salmon spawning streams during any given season. Consequently, low-level aerial surveys from single-engine fixed-wing aircraft or helicopters form an integral component of the escapement assessment program. Nevertheless, comprehensive assessment projects employing such techniques as intensified ground surveys, mark-and-recovery methods, counting towers, weirs, and hydroacoustics are also conducted. Regardless of the method utilized, the overall objective of escapement assessment in the Yukon River drainage is to estimate abundance (or often indices of relative abundance), timing, and distribution of spawning salmon populations.

Perhaps the greatest advantage of aerial surveys is the cost-effectiveness of obtaining escapement information throughout an extremely vast area, most of which is remote. Another advantage to aerial surveillance is that real or potential habitat-related problems arising from natural or man-induced causes can be readily identified. Among the disadvantages are that results may be highly variable if non-standardized procedures are used. Variability in aerial survey accuracy is dependent upon a number of factors such as weather and water conditions (turbidity), timing of surveys with respect to peak spawning, aircraft type, survey altitude, experience of both pilot and observer, and species of salmon being estimated. It is generally recognized that aerial estimates are lower than actual stream abundance due to these factors. Further, peak spawning abundance measured by aerial survey methods is significantly lower than total season abundance due to the die-off of early spawners and arrival of later fish. Also, aerial estimates in a given stream may demonstrate a wide range in the proportion of fish being estimated from year to year. Peak aerial counts, however, can serve either as indices of relative abundance for examination of annual trends in escapement or as a basis from which to estimate total escapement using base year data and established expansion factors.

Aerial escapement estimates are obtained from as many spawning streams as possible within the confines of fiscal, personnel, and weather constraints. However, selected spawning streams have been identified and receive highest priority. Index areas have been designated due to their importance as spawning areas and/or by their geographic location with respect to other salmon spawning streams in the general area. A more comprehensive source of information is presented by L.H. Barton (in Bergstrom et al, In Prep) on the background of the escapement survey project, the methods used, the results and discussion for 1996, and literature references. Some of the spawning escapement information presented here was collected from field projects that were not funded with this U.S.

Department of Commerce grant, but the information is presented here along with the escapement survey data funded by the grant in order to provide a more complete overview of the escapement information.

Biological escapement goals (BEG's) have been established for several Yukon River salmon spawning streams or areas. These goals represent the approximate minimum number of spawners considered necessary to maintain the historical yield from the stocks and are based upon historical performance, i.e., they are predicated upon some measure of historic averages. Establishment of escapement goals for specific spawning stocks based upon a rigorous analysis of maximum sustained yield (MSY) is not feasible at this time due to the nature of the Yukon River mixed stock fisheries, lack of stock identification data, and the inability to reconstruct inriver stock-specific returns.

Chinook Salmon

Chinook salmon escapement goals established by ADF&G for eight Alaskan streams, or index areas, are: East (>1,500) and West Fork (>1,400) Andreafsky, Anvik (>1,300 entire drainage or >500 Yellow River to McDonald Creek), North (>800) and South Fork (>500) Nulato, Gisasa (>600), Chena (>1,700), and Salcha (>2,500) Rivers. These escapement goals are based upon aerial survey index counts which do not represent total escapement.

Yukon River chinook salmon run strength in 1996 was considered to be average. While escapement goals were achieved in the Tanana River drainage as well as in the Canadian portion of the drainage, escapement goals in many tributary streams below the Tanana River were likely not reached. For example, an aerial count of 624 chinook salmon in the West Fork Andreafsky River was 55% below the minimum goal of 1,400 fish. Although the East Fork Andreafsky River was not surveyed due to poor survey conditions, the USFWS weir count of 2,955 chinook salmon was only half of the number passed in 1995.

An aerial survey flown of the Anvik River mainstem index area on 22 July under good survey conditions resulted in a count of 709 chinook salmon. This exceeded the mainstem index area minimum goal of 500 fish by 42%. However, the survey count for the entire river on the same day (including tributaries) was only 839 chinook salmon. This was 35% below the minimum goal of 1,300 fish for the entire drainage. An aerial survey was conducted of a portion of the Nulato River on 20 July under fair survey conditions. Only 100 chinook salmon were counted in the South Fork, including that section of the main river below the confluence of the South Fork. The North Fork Nulato River was not surveyed due to poor weather. Aerial survey minimum escapement goals are 800 and 500 chinook salmon for the South Fork and North Fork Nulato River, respectively. The estimated number of chinook salmon passing the Nulato River tower, operated jointly by the Nulato Tribal Council (with support from the Bering Sea Fishermen's Association) and ADF&G in 1996, was only 808 fish. This estimate was 43% lower than the 1995 tower estimate of 1,412 chinook salmon.

Although no aerial survey was flown of the Gisasa River in the Koyukuk River drainage in 1996 due to unfavorable weather, the USFWS weir count was 1,952 chinook salmon, which was one-half of the 1995 level. Chinook salmon escapement goals have not been established for other streams in the Koyukuk River, but results of aerial surveys made on a few other tributaries in 1996 indicated escapements were relatively low. For example, counts were 69 chinook salmon in Henshaw Creek and 95 in Jim River.

Since 1993, inseason assessment of chinook salmon escapement to the Tanana River drainage has been based on chinook salmon passing the Chena and Salcha River counting tower sites operated by ADF&G Sport Fish Division. High and turbid water conditions hampered operations on both rivers in 1996. During the period 8-28 July towers were only operational for 17 days on the Chena River and 16 days on the Salcha River. Estimated passage during this period was 1,989 chinook salmon in the Chena River and 2,875 in the Salcha River. As a result of the incomplete tower estimates, post season mark-recapture was conducted to estimate spawner abundance in index areas of both rivers. Preliminary estimates of escapement were 7,153 and 7,570 chinook salmon for the Chena and Salcha River, respectively. Aerial surveys of the Chena and Salcha Rivers conducted on 19 July under fair survey conditions resulted in chinook salmon counts of 2,111 and 4,800 fish in the index areas for each river, respectively, indicating that the escapement goals were achieved in both rivers. The Chena River aerial survey count was 24% above the minimum goal of 1,700 chinook salmon, while the Salcha River aerial survey count was 92% above its minimum goal of 2,500 fish.

Observations of chinook spawning to other tributaries of the Tanana River drainage were limited in 1996 due to poor weather and survey conditions. A cursory fly-over of a portion of Barton Creek in the Toklat River drainage on 25 July resulted in a count of 111 chinook salmon. On the same day a poor survey of the mainstem Bearpaw River between Diamond and Glacier Creeks documented at least 107 chinook salmon present. Only 21 chinook were seen on a fair survey of Seventeen Mile Slough on 25 July.

The preliminary DFO mark-recapture population estimate of chinook salmon entering the Canadian portion of the mainstem Yukon in 1996 was 47,955. Subtracting the estimated Canadian commercial and non-commercial harvest (excluding Old Crow) from this population estimate results in a spawning escapement estimate to Yukon Territory (excluding the Porcupine River drainage) of 27,934 chinook salmon. This level of escapement approximated the goal of 28,000 chinook salmon set by the Yukon River Panel in the spring of 1996. Yukon Territory chinook salmon spawning streams surveyed by DFO in 1996 included a ground survey of Tatchun Creek, and aerial surveys of Tincup Creek (Kluane River drainage), the Little Salmon, Ross (Pelly River drainage), Big Salmon, Nisutlin and Wolf Rivers (Teslin River drainage). Results from these surveys indicated that escapements ranged from between approximately 45% above to 220% above the 1991-1995 average escapements for these streams. Those escapements observed in index areas of the Little Salmon, Big Salmon, and Wolf Rivers were the highest on record.

Summer Chum Salmon

Summer chum salmon escapement goals established by ADF&G for seven spawning streams are: East (>109,000) and West Fork (>116,000) Andreafsky, Anvik (>500,000), North Fork Nulato (>53,000), Clear Creek (>8,000) and Caribou Creek (>9,000) in the Hogatza River drainage, and the Salcha River (3,500) in the Tanana River drainage. With the exception of the Anvik River goal, which is based upon sonar counts, all other goals are based upon aerial survey observations during periods of peak spawning.

The summer chum salmon run to the Yukon River in 1996 was judged to be average to above average with adequate escapements achieved throughout the Yukon River drainage for the third consecutive year. Escapements appeared to be the weakest in those summer chum salmon spawning streams downstream of the village of Koyukuk, excluding the Anvik River. In the Andreafsky River a total of 105,472 summer chums were counted past the USFWS weir on the East Fork. This was 39% lower than the 1995 weir count and lower than the aerial escapement goal of 109,000 chum salmon for this tributary. However, it should be noted that the aerial escapement goals for both the East Fork and West Fork Andreafsky River are under further review. No aerial surveys could be flown of the Andreafsky River in 1996 due to poor weather conditions. By comparison, the preliminary sonar estimated escapement of 933,240 summer chum salmon in the Anvik River in 1996, while being 30% lower than that estimated in 1995, was 87% above the minimum goal of 500,000 summer chum salmon for that stream.

Summer chum salmon escapements between Anvik and Koyukuk were judged to be near average based upon observations made in the Rodo River, Kaltag Creek and Nulato River. An aerial survey flown of the Rodo River on 20 July under fair survey conditions resulted in an estimate of 4,400 summer chum salmon. Escapement in Kaltag Creek was estimated to be 51,300 summer chum salmon for the period 20 June through 21 July, based upon a tower counting project operated by the City of Kaltag with funding support from BSFA. No summer chum salmon escapement goal exists for this stream. Estimated summer chum escapement into the Nulato River (both forks combined) was 136,781 based upon the previously mentioned Nulato River tower counting project. This estimate is 42% below the 1995 level. An aerial survey was flown on 20 July of the South Fork Nulato River, including the mainstem section below the forks, but was incomplete and conducted well after peak spawning. The North Fork was not surveyed in 1996.

In the Koyukuk River drainage, a total of 157,589 summer chum salmon were counted past the USFWS weir on the Gisasa River, which was 16% higher than the 1995 weir count. Summer chum salmon escapement in Clear Creek (Hogatza River drainage) was estimated as 101,250 salmon based upon a tower counting project conducted by the USFWS and BSFA. This level of escapement was similar to that observed for this stream during the first year of tower operations in 1995. A helicopter survey of Caribou Creek made by BLM on 13 July indicated that the minimum escapement goal (>9,000) to that stream was achieved. An estimate of 10,470 chum salmon was made on that survey. In addition, BLM also documented several thousand summer chum salmon spawning in portions of the

upper Hogatza River drainage on 13 July. Fish were observed in portions of the mainstem river as well as in several miles of Klikhtentozna Creek. These latter observations resulted in nominations to the state's *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes*, extending the range of summer chum salmon in this drainage. Other summer chum salmon escapements documented in portions of the upper Koyukuk River drainage in 1996 included 12,890 chum salmon in Henshaw Creek estimated from an aerial survey on 24 July, and 37,450 chum salmon passing the USFWS weir on the South Fork Koyukuk River during the period 2 through 28 July.

In the Tanana River drainage frequent interruptions from high and turbid water conditions hampered tower operations in 1996. During the period 8-28 July, towers were only operational for 17 days on the Chena River and 16 days on the Salcha River. Passage estimates during this period were 12,162 chum salmon on the Chena River and 74,912 chum salmon on the Salcha River. The Chena River estimate was more than double the average for the same period from previous years. The Salcha River tower estimate was the highest on record. An aerial survey was conducted on both rivers on 19 July. However, the surveys were rated "poor" for chum salmon because they were conducted prior to peak of spawning. Results from these surveys provided summer chum index counts of 2,075 and 9,762 in index areas of the Chena and Salcha Rivers, respectively. The Salcha River estimate was the second highest on record and indicated the aerial survey-based minimum escapement goal of 3,500 summer chum salmon was achieved.

Fall Chum Salmon

The most complete database on Yukon River fall chum salmon escapements dates back to the early 1970's and exists for four spawning areas: the Delta, Upper Toklat, Sheenjek, and Fishing Branch Rivers. Escapement goals for these spawning areas are >11,000, >33,000, >64,000, and 50,000-120,000 fall chum salmon, respectively. These goals are of total estimated abundance for these streams or spawning areas, and are based upon ground surveys for the Delta and Upper Toklat Rivers, sonar passage estimates for the Sheenjek River, and a weir count for the Fishing Branch River. In addition to these estimates, annual estimates of border passage and subsequent spawning escapement are available since 1982 for the fall chum stock in the mainstem Yukon River in Canada. The escapement goal for this stock is >80,000 fall chum salmon spawners.

The overall run of Yukon River fall chum salmon in 1996 was evaluated inseason to be substantially greater than the preseason projection of 631,000 fish. Inseason assessment of lower and upper river test fish data and escapement information suggested that the non-Tanana River run component, in particular, was similar in magnitude to that realized in 1995. Subsequent escapement estimates made for the Chandalar River (208,000), Sheenjek River (248,000), Fishing Branch River (77,300), and upper Yukon Canadian stocks (122,700) were in fact all very similar in magnitude to the large escapements realized in 1995.

By comparison however, test fishery results from the south bank Yukon River near Tanana as well as those in the Tanana River suggested Tanana River fall chum salmon run size to be comparatively smaller. The preliminary mark-recapture chum salmon abundance estimate for the upper Tanana River (135,000), upstream of the Kantishna River, is less than half the 1995 abundance estimate (268,000) for those stocks. Although achieved in the Delta River, the escapement goal was not achieved in the Upper Toklat River in 1996.

Assessment of escapement to the Porcupine River drainage was based upon observations made in the Sheenjek and Fishing Branch Rivers. The sonar-estimated escapement in the Sheenjek River in 1996 was 248,000 chum salmon for the 57-day period 30 July through 24 September, the largest on record. This is nearly 3.9 times the minimum escapement goal of 64,000. The minimum escapement goal for the Fishing Branch River (50,000) was achieved for the third consecutive year and the third time since 1985. Approximately 77,300 chum salmon were enumerated through the weir during the 65-day period of 19 August through 22 October. This was the largest escapement observed in the Fishing Branch River since 1979.

Other indicators that good fall chum escapements were realized to other areas throughout the Yukon River drainage in 1996, excluding the Tanana River, were evident. For example, the USFWS-operated sonar project on the Chandalar River, although in its third year of development using split beam sonar, resulted in a passage estimate of 208,170 fall chum salmon for the 45-day period 8 August through 21 September. The USFWS also counted 21,651 chum salmon at South Fork Koyukuk River weir in 1996 during the period 17 August through 19 September. High water prevented weir operations for a two- to three-week period prior to 16 August. Although 1996 was the first year a weir was operated on this river, the minimal passage estimate compares to a sonar passage estimate of approximately 19,500 chum salmon from 2 August through 25 September in 1990.

Tanana River fall chum salmon escapement in 1996 was evaluated by observations made in the Toklat and Delta Rivers. Population estimates of fall chum escapement for the Toklat River have historically been expanded aerial or ground survey counts made during periods of peak spawning at Toklat Springs in the Upper Toklat River, using spawner residence data collected from the Delta River stock. However, since 1994 a sonar project has been in development on the Toklat River.

In 1996, a preliminary sonar passage estimate of approximately 89,000 fish was obtained for the period 14 August through 1 October. This estimate is not speciated. By comparison, ground surveys conducted of Toklat Springs during mid-October resulted in a count of only 16,206 chum and 276 coho salmon. The chum salmon count expanded to a total abundance estimate of approximately 18,800 fish; less than 25% of the sonar fish passage estimate. Thus, the minimum escapement goal of 33,000 chum salmon, which is predicated upon expanded survey observations made at Toklat Springs, was not achieved in 1996. An aerial survey flown of the Toklat River floodplain between Toklat Springs and the sonar site in late October only accounted for an additional 5,170 chum and 358 coho salmon.

Although estimates of abundance using sonar techniques have been higher than those generated from subsequent ground surveys on the Upper Toklat River in all three years, preliminary results indicate the variation in disparity between the two estimates among years has been substantial. Thus, the sonar project remains in a developmental stage until a better understanding of inriver salmon run timing and spawner distribution (by species) is obtained for the Toklat River. Such will be essential in qualifying the relationship of sonar passage estimates of abundance with estimates obtained from subsequent spawning ground surveys.

The preliminary estimate of the total abundance of fall chum spawners in the Delta River in 1996 is 19,758, approximately 80% above the minimum escapement goal of 11,000 chum salmon. While no escapement goals exist for other fall chum salmon spawning areas in the upper Tanana River, escapement during peak spawning was estimated at 3,920 in Bluff Cabin Slough (Big Delta region). This is 79% below what was observed in 1995 (19,460) and well below the 1986-1995 ten-year average of 6,200 fish.

The cooperative ADF&G and BSFA Tanana River fall chum salmon mark-recapture project resulted in a total of 4,016 chum salmon being tagged and released from 16 August through 30 September. The preliminary total abundance estimate of the number of chum salmon which passed the tagging site located on the mainstem Tanana River upstream of the Kantishna River mouth is approximately 135,000 fish; 50% of the 1995 estimate of 268,000.

The mark-recapture population estimate of fall chum salmon entering the Canadian portion of the upper Yukon River made by DFO in 1996 was 143,758 fish. Subtracting estimated Canadian commercial and non-commercial harvest (excluding Old Crow) from this population estimate results in a total escapement estimate to Yukon Territory (excluding the Porcupine River) of 122,688 spawners. An escapement level of this magnitude is the second highest on record since inception of the DFO mark-recapture program in 1982. Further, it is 86% above the targeted 1996 escapement level of 65,000 fall chum as part of a three step plan to rebuild the 1988 parent year to a minimum of 80,000 chum salmon by the year 2000.

Preliminary estimates of fall chum salmon inriver commercial and subsistence harvest of 276,000, when added to an estimate of drainage-wide total spawning escapement of 723,200, based upon a doubling of a standardized escapement index, resulted in a 1996 total run size estimate of approximately 999,400 chum salmon. This measure of run size was the largest even-year return on record and 58% above the preseason projected return of 631,000 fall chum salmon.

Coho Salmon

Coho salmon spawning escapement assessment is very limited in the Yukon River drainage due to funding limitations and often marginal survey conditions which prevail during the periods of peak

spawning. While most escapement information on coho salmon is from the Tanana River drainage, cooperative efforts of USFWS and BSFA in 1996 allowed the East Fork Andreafsky River summer season weir project to be extended into September for a second year. This provided comprehensive escapement information concerning timing and abundance of coho salmon to a tributary in the lower Yukon River. A total of 8,037 coho salmon were passed through 16 September, the last day of weir operations in 1996. This compares to 10,901 coho salmon counted past the weir through 12 September in 1995.

The USFWS also operated a weir on the South Fork Koyukuk River in 1996 to monitor salmon escapements. The weir became operational on 2 July. Although operations were suspended during the first half of August as a result of high water, the weir became operational again for the period 16 August through 19 September. No coho salmon were passed.

Presently, the only escapement goal which has been established for coho salmon is for the Delta Clearwater River (DCR) in the Tanana River drainage. The minimum goal is 9,000 coho salmon based upon a boat survey during peak spawning. In 1996, the Sport Fish Division conducted a boat survey of the DCR index area on 29 October and estimated 14,075 coho salmon present, 59% above the minimum goal. An additional 3,300 coho salmon were observed in tributaries of the DCR by helicopter on 22 October. The Sport Fish Division also documented 1,125 coho salmon present in the outlet stream of Clearwater Lake from an aerial survey flown on 22 October.

Remaining escapement information on coho salmon in 1996 was obtained primarily by aerial surveys in portions of the Tanana River drainage, although limited ground surveys were also conducted at a few locations. A large part of this work was conducted by the Tanana Chiefs Conference, particularly in the Nenana River drainage. Estimated numbers of coho salmon spawners in the Nenana River drainage included 2,040 in Lost Slough, 3,668 in Seventeen Mile Slough, 2,171 in the mainstem Nenana River upstream of the Teklanika River, and approximately 5,000 in the Clear-Glacier-Wood Creek complex of the Julius Creek drainage. An additional 909 coho salmon were observed in the Teklanika River drainage. In the Toklat River drainage, only 233 coho salmon were counted in Geiger Creek while none were passed at Barton Creek weir nor any seen below the weir during the entire period 22 August through 1 October.

LOWER YUKON RIVER SONAR AT PILOT STATION, 1996

Salmon are harvested for commercial and subsistence purposes over more than 1,600 km of the Yukon River in Alaska and Canada. These salmon fisheries are critical to the people and economy of dozens of communities along the river, in many instances providing the largest single source of food and/or income to local residents. Management of the fisheries is complex and difficult for many reasons, including the broad geographic distribution of the many individual salmon spawning stocks that support these fisheries.

Sonar estimates of fish passage from the lower Yukon River sonar project at Pilot Station are available in a more timely and comprehensive manner than can be obtained from other sources. The project design incorporates fish passage estimates from shore-based single-beam sonar data, and species composition estimates from drift gill net test fishing with a suite of mesh size gill nets, to estimate daily upstream passage of fish by species. The sonar project is deployed at the historical location at river km 197 near Pilot Station, which is far enough upriver to avoid the wide multiple channels of the Yukon River delta, but far enough downstream to provide timely information for inseason management of the Yukon River fisheries.

This project has produced estimates of daily upstream fish passage annually since 1986, except for 1992, when it was operated for experimental purposes only, and 1996 when it was operated for training purposes only. Project sonar equipment was reconfigured prior to the 1993 season to operate at a frequency of 120 kHz as compared to the former 420 kHz, which has significantly extended the effective range of the sonar beams and avoids signal loss encountered at the 420 kHz operating frequency. Project objectives in 1996 were to provide a full spectrum of training opportunities for a largely new field crew during an abbreviated project operational period, and to perform some long deferred maintenance on project field facilities. Training covered all aspects of normal field operations and included acoustic and non-acoustic data collection and processing, though not necessarily simultaneously. Gill net catch information was forwarded to managers, and all catch data were added to the historic database used to update project size-dependent catchability relationships. Additionally, climatologic and hydrologic data were collected throughout the field season.

During training, all normal data collection procedures were closely followed. Aiming criteria, which were changed in 1995 to maximize the detection of passing fish, were maintained. As a consequence, all detected fish were again classified as upstream traveling. A more comprehensive source of information on the background of this project, the methods used, the results and discussion for 1996, and literature references can be found in Maxwell and Huttunen (In Prep).

Historical salmon passage estimates at Pilot Station have been based upon a sampling design in which acoustic data were typically collected for 9.0 hours each day. This sampling schedule was adhered to in 1996 for three days per week. In addition, gill net catch data were collected during intervals absent acoustic sampling. Typical gill net sampling schedules were adhered to during the two days of the normal work week not acoustically sampled. Training on data entry, processing, and analysis, and on equipment diagnostic techniques occurred between acoustic and gill net training schedules.

Sonar project training activities were conducted from 24 June through 25 August in 1996. Passage estimates were not generated in 1996. Gill net catch data were relayed to area managers in Emmonak during the field season to provide some general information on species presence/absence.

Bottom profiles were conducted throughout the season along the left and right banks, revealing evenly sloping bottom topography similar to those recorded at transducer locations used in previous years.

No changes were noted in the steeply sloping, rocky bottom along the right bank during the field season. Bank-to-bank transects were conducted every other day in 1996 revealing few fish passing in unensonified areas of the river. Transect data are not incorporated into the estimation process; they are intended to document the presence/absence of fish in unensonified areas.

Initial training was conducted on deployment and transducer pod recovery techniques. Transducer assemblies were deployed at typical near shore locations on the right and left banks, and at the typical offshore location 60m outward from the left bank.

Training on transducer aiming and aim verification, perhaps the single most important element affecting fish detection, occurred repeatedly throughout the field season. All transducers were aimed closely along the bottom, where the majority of the fish are known to migrate. The right bank transducer rarely required reaiming. The left bank near shore transducer requires regular reaiming during sampling activities. Both left bank transducers require reaiming at intervals not to exceed two days.

Several training sessions were conducted in bottom mapping techniques. Water depth information was collected at precisely known locations, and these data were processed to generate bathymetric maps of the river in the vicinity of the sampling activities several times over the course of the field season. These maps allow monitoring changes in the bottom topography which may affect fish migratory behavior and subsequent detection.

A total of 1,285 fish were captured during drift gill netting activities in 1996. The catch included 19 chinook salmon, 852 chum salmon, 50 coho salmon, 246 pink salmon, and 118 whitefish and other species. The vast majority of the captured fish were given to local residents.

Deferred maintenance at the field project included construction of new right bank and left bank sonar wall tent frames, an equipment storage frame, and a new mess tent frame.

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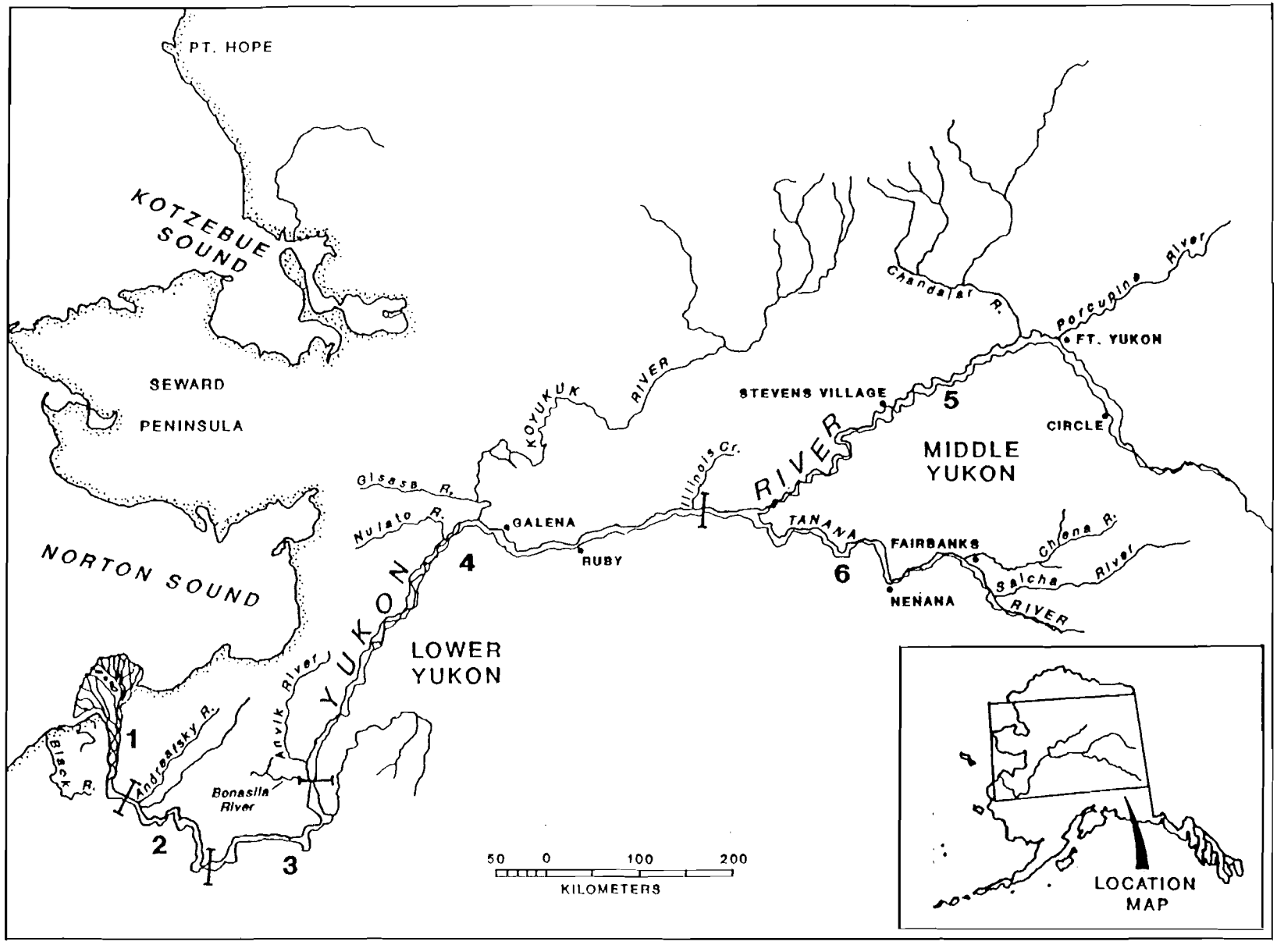

Figure 1. Alaska portion of the Yukon River drainage, showing fishing district boundaries.

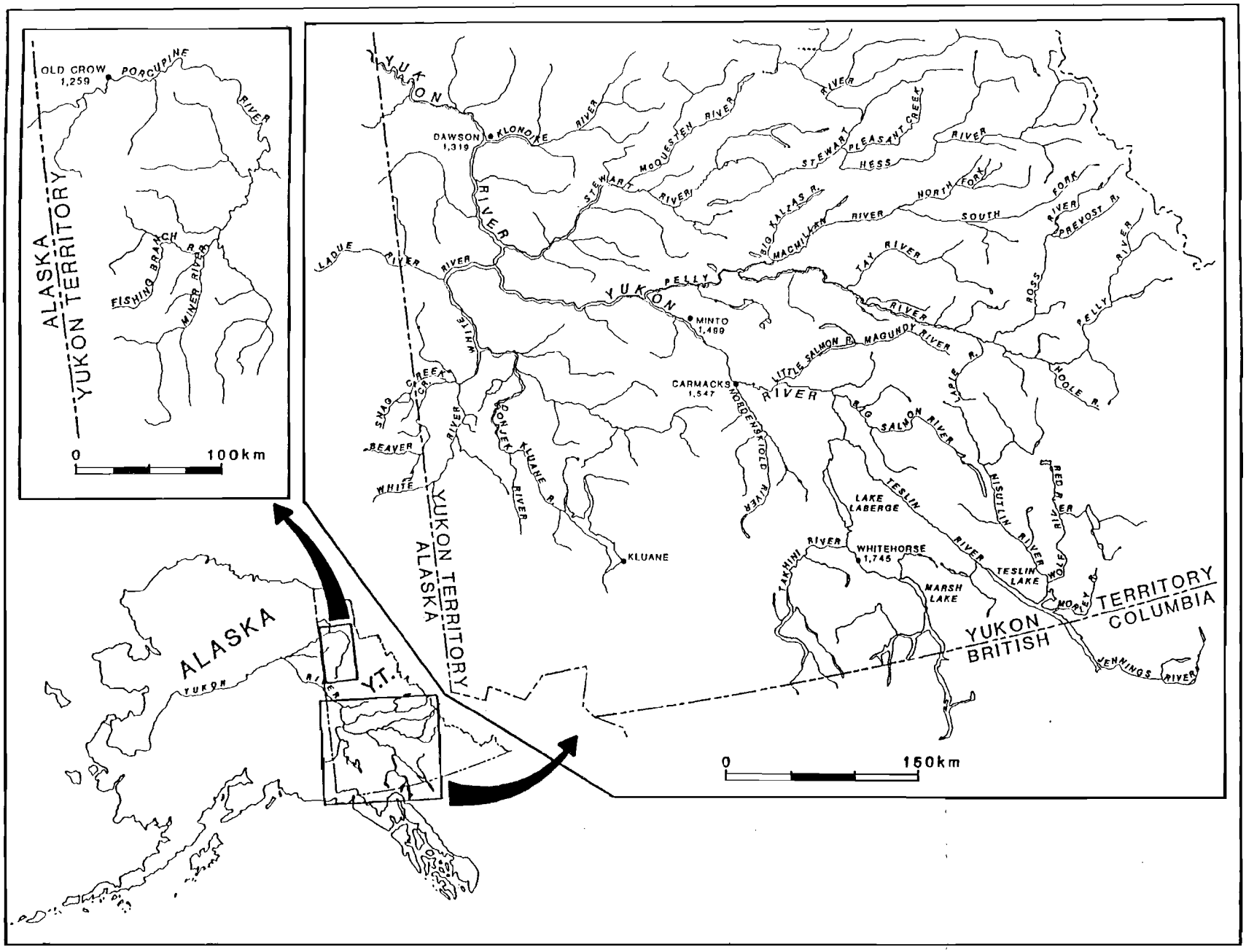

Figure 2. Canadian portion of the Yukon River drainage.